



**NORTH PARK
UNIVERSITY
CHICAGO**

**DEPARTMENT OF PHYSICS AND ENGINEERING
(PHEN)**

**BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
(BSME)**

PROGRAM CATALOG – 2024-2025

Full-time Faculty

George Quainoo, Ph.D., Professor and Department Chair

Libin K Babu, Ph.D., Associate Professor

Jie Yao, Ph.D., Assistant Professor

Visiting Faculty

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Staff

Madalynn Baez, Lab Manager

At North Park University, our Bachelor of Science in Mechanical Engineering (BSME) program combines rigorous academic training with our core values of Christian faith, intercultural understanding, and a city-centered approach. Rooted in a mission to foster holistic education, students benefit from small class sizes that allow for personalized instruction and hands-on experience with state-of-the-art equipment. The program offers access to industry experts and real-world projects, preparing graduates to excel in their field while embodying ethical leadership and a commitment to serving diverse communities.

Philosophy of the PHEN department: Our educational philosophy is based on the following values:

- (1) excellence – we expect excellence from our faculty and students in all classes.
- (2) hard work – the pursuit of truth through engineering requires diligence, determination, and perseverance.
- (3) empowerment – students who succeed in engineering will know they can succeed at anything.
- (4) responsibility – with knowledge comes the responsibility to ensure that knowledge is applied ethically and carefully.
- (5) teamwork – no matter what background one comes from, engineering students are united by common goals.
- (6) passion – the path to true understanding can only be pursued by a passionate learner.

The BSME program is based on the commitment to preparing the next generation of engineers through a comprehensive education that combines strong theoretical foundations, practical experiences, and relevant industry engagement. Our mission is to equip graduates to excel in their professional engineering careers while addressing the challenges and needs of society. Specifically, our program aims to develop engineers who are ready to practice at the highest professional standards and make a meaningful impact in the world.

The Program Educational Objectives (PEOs) for the BSME program are as follows:

1. Graduates will utilize their knowledge in mechanical engineering to address and resolve complex technical challenges effectively and ethically within professional settings.

2. Graduates will exhibit professional development through ongoing education, attainment of relevant certifications, or increased job responsibilities within their roles.
3. Graduates will make meaningful contributions to the community by focusing on public welfare, adhering to ethical standards, and considering the global ramifications of engineering solutions.
4. Graduates will demonstrate effective teamwork by employing robust communication skills to collaborate successfully with professionals from diverse backgrounds.

MECHANICAL ENGINEERING

Mechanical engineering remains one of the most versatile and broadest fields of engineering, with professionals in this discipline contributing to nearly every industry, especially in a thriving urban environment like Chicago. In the 21st century, mechanical engineers play pivotal roles in sectors such as advanced manufacturing, transportation, healthcare technology, and sustainable energy solutions. The Midwest, known for its strong industrial base, offers a growing demand for mechanical engineers, particularly in areas like automotive innovation, aerospace, renewable energy, and urban infrastructure development.

Mechanical engineers in Chicago are at the forefront of designing and developing a wide range of machinery, from electric vehicles to cutting-edge medical devices. They oversee the planning, design, manufacturing, and operation of these technologies, while also addressing the energy needs and environmental challenges of a modern city. Mechanical engineers are key contributors to energy production and efficiency, working on advanced power systems, sustainable HVAC solutions, and smart infrastructure, making their expertise essential in the ongoing transformation of the Midwest's economy and its adaptation to future technologies.

Bachelor of Science in Mechanical Engineering Program Student Learning Outcomes (PSLOs)

- (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare as well as global, cultural, social, environmental, and economic factors.
- (3) an ability to communicate effectively with a range of audiences.
- (4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

PROGRAM REQUIREMENTS

Students who choose this option will complete the following 124-credit hour program of study:

Core Curriculum Requirement (52 credits)

Core credits with non-major related courses – 32 credits

Core credits with major-related courses – 20 credits

Major requirements (92 credits)

Basic math and science pre-requisites and supporting courses (32 credits)

MATH 1510 Calculus I

MATH 1520 Calculus II

CHEM 1150 General Chemistry I

PHEN 1210 Introductory Physics I

PHEN 1220 Introductory Physics II

MATH 2030 Differential Equations

PHEN 2220 Engineering Math and Programming

MATH 3050 Vector Calculus or MATH 3010 Linear Algebra

Mechanical Engineering courses (60 credits)

PHEN 1330 Mechanical Comprehension

PHEN 1135 Intro to Fabrication Skills I

PHEN 1165 Intro to Fabrication Skills II

PHEN 1410 Engineering Ethics

PHEN 2310 Computational Tools for Engineering

PHEN 2535 Intro to Material Science

PHEN 2550 Engineering Statics

PHEN 2560 Dynamics

PHEN 2625 Electronics

PHEN 3540 Mechanics of Materials

PHEN 3715 Engineering Thermodynamics

PHEN 3725 Fluid Mechanics

PHEN 4010 Fourth Year Seminar

PHEN 4020 Engineering Economics

PHEN 4310 Design Thinking

PHEN 4330 Machine Design and Analysis

PHEN 4610 Systems
PHEN 4755 Heat and Mass Transfer
PHEN 4990 Engineering Capstone Project

ADMISSION REQUIREMENT

Prospective students are required to:

- Submit a Higher School Diploma or Equivalent (GED) along with high school transcripts
- Cumulative high school GPA of 2.50 (unweighted)
- Cumulative college GPA (transfer students) 2.0 (based on 12 or more transferable credits)
- A personal essay describing why you are interested in attending North Park University and why you believe you would be a good fit here (up to 500 words)
- Activities and involvements that reflect your initiative, leadership, personal character, and values
- Recommendations from your teachers, community leaders, pastors, etc.
- Apply through the Common Application or NPU's online portal

ACCREDITATION

North Park University's accreditation by the Higher Learning Commission (HLC) was recently reaffirmed on July 16, 2021. The Commission is recognized by the U.S. Department of Education and the Council of Higher Education Accreditation (CHEA) which is responsible for ensuring accrediting bodies and institutions uphold and meet the established standards of quality.

North Park University has been continuously accredited by the Higher Learning Commission since 1926.

COURSE DESCRIPTIONS

PHEN 1330 Mechanical Comprehension

This course is an introduction to a variety of practical, real-world tools used in physics and engineering to solve problems and complete projects. This course includes an introduction to (1) sketching and visual representation for mechanical and product design, (2) the function of common mechanisms, (3) fabrication methods and prototyping and production, and (4) technical drawing and computer-aided modeling. Offered in the Fall semester.

Two credit hours.

Pre-requisite: None

PHEN 1135 Intro to Fabrication Skills I

This course is a hands-on lab providing instruction in fabrication skills used throughout the mechanical engineering program. Key equipment covered in this course includes CNC lathes, mills, and routers. An introduction to 3D printing will be provided in this

course. Safety training on the usage of the equipment and the general use of the machine shop and other labs will be included. Offered in the Fall semester.

Two credit hours.

Pre-requisite: PHEN 1330

PHEN 1165 Intro to Fabrication Skills II

This course provides advanced training for skills covered in [PHEN 1135](#). It involves the creation of complex fabricated samples utilizing a combination of different CNC equipment and a variety of wood shop tools. Offered in the Spring semester.

Two credit hours.

Pre-requisite: PHEN 1135

PHEN 1410 Engineering Ethics

Moral values permeate all aspects of technological development. Ethics and excellence go together. This course is an introduction to ethics in the context of the engineering profession. The course will include a discussion of current accepted moral frameworks and ethical theories; the study of decisions, policies, and values involved in engineering practice; and the responsibilities and rights endorsed by the engineering community. Through a critical reading of the Engineering Code of Ethics, traditional textbooks, and the consideration of case studies in engineering the class will explore moral challenges faced by engineers in today's society. Offered in the Spring semester.

Two credit hours.

Pre-requisite: None

PHEN 2310 Computational Tools for Engineering

This course is an introduction to computational tools in engineering and physics. This course uses spreadsheets (Excel) and an interpreted language (MATLAB) to complete typical tasks in engineering. Topics include graphing and visualization of data; spreadsheet development (e.g., formulas, data validation, conditional formatting); introduction to basic programming (variables, branching, looping, functions) to solve numerical problems. Offered in the Fall semester.

Two credit hours.

Pre-requisite: MATH 1510

PHEN 2535 Introduction to Material Science

This course introduces the science and engineering of materials such as metals, ceramics and glasses, polymers, and composites. Topics include: crystals, defects, non-crystalline structures, phase diagrams, kinetics, processing, degradation, and failure of materials. Lab is included in this course. Offered in the Fall semester.

Four credit hours.

Pre-requisite: PHEN 1210, 1220 grades of C or better

PHEN 2550 Engineering Statics

This course will cover the application of the basic principles of Newtonian mechanics to the statics of particles and the equilibrium of structures along with other rigid bodies. Primarily, statics involves the evaluation of external and internal forces on right-body systems. Key topics of discussion will include forces; moments; trusses; beams; free body diagrams; friction; equilibrium; centers of gravity; moments of inertia; and bending

moments in structural members. A brief introduction to stress and strain will be included. Prior knowledge of vector algebra and calculus will be handy. Offered in the Fall semester. Four credit hours.

Pre-requisite: PHEN 1210 and MATH 1510 with grades of C or better.

PHEN 2560 Dynamics

This course is the study of objects in motion. Topics include particle kinematics and kinetics; work, energy, momentum, and impulse applied to systems of particle and rigid bodies. Offered in the Spring semester.

Four credit hours.

Pre-requisite: MATH 1520 and PHEN 2550 with grades of C or better.

PHEN 2625 Electronics

This course offers a theoretical and practical introduction to DC and AC circuits. Topics covered include: analysis of linear circuits, circuit laws and theorems, DC responses of circuits; operational amplifiers characteristics and applications, sinusoidal steady-state analysis and phasors, and sinusoidal steady-state power calculations. Emphasis will be placed on both the mathematical methods as well as the "rules of thumb" used in everyday laboratory settings. Lab is included in this course. Offered in the Spring semester.

Four credit hours.

Pre-requisite: PHEN 1210 and 1220 with grades of C or better.

PHEN 3540 Mechanics of Materials

This class will include the determination of stresses, deflections, and stability of deformable bodies. Topics covered include statically indeterminate problems in axially loaded bars; normal shear stress in symmetrically loaded beams; normal and shear stress in unsymmetrically loaded beams; deflections in beams and statically indeterminate beam problems; structural analysis using energy methods; stability of columns and allowable loads. Offered in the Spring semester.

Four credit hours.

Pre-requisite: PHEN 2550 with a minimum grade of C.

PHEN 3715 Engineering Thermodynamics

The fundamental mass and energy conservation laws and entropy balances are developed and applied to closed and open systems. The concepts of heat and work transfer between thermodynamic systems and their surroundings are discussed. The thermodynamic properties of common working substances are studied. These concepts are applied to the analysis of energy conversion systems with examples to include thermal power plants and refrigeration systems. Lab is included in this course. Offered in the Fall semester.

Four credit hours.

Pre-requisite: PHEN 1210 and 1220 with grades of C or better.

PHEN 3725 Fluid Mechanics

This course involves the study of fluid flow and its mathematical description. Basic concepts such as continuum, velocity field, and vorticity will be introduced. Application of physical principles such as mass conservation, momentum conservation velocity

potential, stream function for various types of flow across bodies will be covered. Internal flows including pipe flow and external flow such as airfoils will be included. This course will provide a basic introduction to computational fluid dynamics. Lab is included in this course. Offered in the Spring semester.

Four credit hours.

Pre-requisite: PHEN 3715

PHEN 4010 Fourth Year Seminar

This course is intended to help students begin to make the transition from student to professional. The course will have three main goals: 1) to help students examine their goals as they enter graduate school or the private sector; 2) to help students prepare for the departmental comprehensive exam; and 3) to begin to familiarize students with the literature in their field of study. Offered in the Fall semester.

Two credit hours.

Pre-requisite: Fourth-year standing in engineering major/advisor consent.

PHEN 4020 Engineering Economics

This course is intended to provide engineers with skills to assess the benefit-cost of engineering investments, such as the development of technology and products. This course will cover the framework for capital purchases, replacement considerations, management of technologies over their lifecycles, and for evaluating the optimum use of resources. Offered in the Spring semester.

Two credit hours.

Co-requisite: PHEN 4990

PHEN 4310 Design Thinking

This course is an introduction to the engineering design process. Come learn by doing, diving into communities to get to know stakeholders, and identifying what can be improved. Iterate solutions while balancing constraints and leveraging opportunity. Bring a project through a typical design cycle (e.g., needs identification, concept development, prototyping, testing, iteration). Offered in the Fall semester.

Two credit hours.

Pre-requisite: Fourth-year standing in engineering major/advisor consent.

PHEN 4330 Machine Design and Analysis

This course is intended to cover the design of common machine elements such as shafts, fasteners, springs, bearings, and gears. This course will cover the application of materials selection, solid mechanics, vibrations, and failure theories in the analysis of mechanical elements and systems. Finite Element Analysis software will be used for preprocessing, testing, and postprocessing of different mechanisms and designs. Offered in the Fall semester.

Four credit hours.

Pre-requisite: PHEN 3540

PHEN 4610 Systems

We live in a connected world. From the components of your phone to national resource flows to teams of experts, systems enable our everyday lives. Learn how to model engineering systems by considering input flows, system components, outputs, feedback,

and system control strategies. These principles are applied to a varying scale of systems, reinforcing their broad application. Offered in the Fall semester.

Four credit hours.

Pre-requisite: PHEN 1220 and PHEN 2625 with grades of C or better.

PHEN 4755 Heat and Mass Transfer

The course introduces the governing laws for heat and mass transfer. Fundamental concepts such as Steady-state and transient heat conduction, treatment of convection heat and mass transfer, heat transfer with phase change, radiation heat transfer and heat exchangers will be included. Both analytical and numerical solution methods will be covered. Offered in the Fall semester.

Four credit hours.

Pre-requisite: PHEN 3715

PHEN 4990 Engineering Capstone Project

The Engineering, Capstone is the culmination of a student's undergraduate engineering program. Working in a team, students gain hands-on experience solving real-world applications. Capstone projects progress through a typical engineering decision cycle, from user needs identification through testing of a functional prototype. When available, industry partnerships are encouraged.

Four credit hours.

Pre-requisite: Fourth-year standing in engineering major/advisor consent.